United States Patent [19]

Langlois

[11] **4,403,508**

[45] **Sep. 13, 1983**

[54] **LOCATING INTERFACES IN VERTICALLY-LAYERED MATERIALS AND DETERMINING CONCENTRATIONS IN MIXED MATERIALS UTILIZING ACOUSTIC IMPEDANCE MEASUREMENTS**

[75] Inventor: **Gary N. Langlois**, Richland, Wash.

[73] Assignee: **The United States of America** as represented by the U.S. Department of Energy, Washington, D.C.

[21] Appl. No.: **272,227**

[22] Filed: **Jun. 10, 1981**

[51] **Int. Cl.**[3] **G01N 29/02**; G01F 23/28

[52] **U.S. Cl.** ..... **73/589**; 73/290 V

[58] **Field of Search** ..... 73/574, 589, 599, 290 V; 340/621

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,520,186	7/1970	Adams et al.	73/290 V
3,656,134	4/1972	Brown	340/621
3,695,108	10/1972	Wygant	73/290 R
3,791,200	2/1974	Hayre	73/589
3,883,841	5/1975	Norel et al.	73/589
3,889,523	6/1975	Nolte	73/290 V X
4,118,983	10/1978	Brazhnikov	73/290 V X
4,203,324	5/1980	Baumoel	73/290 V
4,320,659	3/1982	Lynnworth et al.	73/589

FOREIGN PATENT DOCUMENTS

720970	11/1965	Canada	340/621

OTHER PUBLICATIONS

"Ultrasonic Methods of Testing Materials" by Filipczynski et al. London, Butterworth's 1966, p. 83.

"Ultrasonic Testing of Materials" by Krautkramer, New York, Springer-Verlag, 1969, pp. 16-23.

Primary Examiner—James J. Gill

Attorney, Agent, or Firm—Robert Southworth, III; Richard E. Constant; Richard G. Besha

[57] **ABSTRACT**

Measurement of the relative and actual value of acoustic characteristic impedances of an unknown substance, location of the interfaces of vertically-layered materials, and the determination of the concentration of a first material mixed in a second material. A highly damped ultrasonic pulse is transmitted into one side of a reference plate, such as a tank wall, where the other side of the reference plate is in physical contact with the medium to be measured. The amplitude of a return signal, which is the reflection of the transmitted pulse from the interface between the other side of the reference plate and the medium, is measured. The amplitude value indicates the acoustic characteristic impedance of the substance relative to that of the reference plate or relative to that of other tested materials. Discontinuities in amplitude with repeated measurements for various heights indicate the location of interfaces in vertically-layered materials. Standardization techniques permit the relative acoustic characteristic impedance of a substance to be converted to an actual value. Calibration techniques for mixtures permit the amplitude to be converted to the concentration of a first material mixed in a second material.

2 Claims, 6 Drawing Figures